Community perceptions of water quality and current institutional arrangements in the Great Barrier Reef Region of Australia

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Abstract

This paper traces the perceived linkages between sources of water quality deterioration, impact on human wellbeing and the institutions responsible for dealing with the sources and impacts. The DPSIR (Driving forces-Pressure-State-Impact-Response) framework is used as a guide for data collection and to structure responses and the emerging themes. The web of linkages, as perceived by residents, is then compared with current institutional arrangements across different relevant sectors.

Taking a case study and exploratory research approach, eleven residents of Whitsunday shire, Queensland, Australia were interviewed about their perceptions of water related issues. This was followed by an analysis of current water management institutions for the region. Significant gaps were found between community concerns regarding water quality and actual institutional arrangements responsible for managing water use and quality. Residents perceived their local government body (Shire Council) as accountable for responding to water-related pressures and impacts in their Shire, whereas the responsibility falls primarily on government agencies and organisations at a regional, state and national level. Improved communication between the council and residents is needed to close these gaps in understanding. Moreover, incorporation of local perceptions and values regarding water pressure, impacts and preferred use into the development of institutional arrangements for water management is suggested.

Keywords: DPSIR; Great Barrier Reef; Institutional analysis; Integrated catchment management; Perceptions of water

1. Introduction

Over the past two decades, the importance of multi-stakeholder governance processes and structures in the water sector (water policy, planning and management) for solving water problems has been increasingly highlighted in both the academic scholarship and applied arenas. One of the more notable

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examples is the European Union’s Water Framework Directive which requires member states to increase public participation in decision making at both policy and planning levels (Directive 2000/60/EC, 2000). Participation in water planning activities in Australia also has considerable history, stemming from the Water Reform Agreement between States and Commonwealth signed in 1994. The key initiatives stemming from this agreement are the improvement of water quality and refinement of water rights and water allocation procedures, as well as the promotion of community participation (Larson, 2006). However, evaluations of recent water planning processes in Australia conclude that the rules and regulations are still viewed by local stakeholders as being “imposed from above”, with varying and often insufficient consultation with the people they will affect (McKay, 2005; Larson, 2006).

The Water Reform Agreement and resulting National Water Initiative, promote two key principles for water planning: microeconomic reform, in particular the use of markets and trading, and community planning (Jackson et al., 2008). Stoeckl et al. (2006) suggest that this combination of privatisation of water and community input in water use through planning mechanisms is likely to lead to conflict. Disagreements might rise over aspects of water use to be determined by the market versus communities and over the resolution of differences between market and community views with respect to water use outcomes.

In the last 15–20 years, Australia has also seen a growth in the numbers of planning requirements related to natural resources, including water, which have resulted in the fragmentation of policy and legislation within and across jurisdictions (Stoeckl et al., 2006). For example, coastal catchments in the state of Queensland are regulated by a dozen statutory plans, based on various acts, as well as an equal number of relevant non-statutory plans (EPA, 2006). A review of Commonwealth, States and Territories legislative requirements for tropical rivers in northern parts of Australia found that there are over 20 policies and programmes that have an impact on water use and 26 pieces of legislation relating to the use of tropical rivers (Hegarty et al., 2005). Some researchers are concerned that increased planning requirements are not necessarily resulting in increased concern for ecological values, nor in improved participation of communities affected (Marsden, 2002). In addition, Gentle & Olszak (2007: p 62) highlight that the delivery of water plans is often delayed as a result of a “lack of practical and realistic operational policies in relation to economic, social and cultural issues”, “inexperience of technical planners in dealing with complex economic and social issues and processes” and “inexperience of stakeholders and community groups in dealing with conflicts with government and water planners over science, economic and social impacts, values, information and institutions”.

This paper aims to investigate perceptions of community residents of a coastal shire regarding water quality and institutional arrangements. Taking a case study and exploratory research approach, this paper traces the perceived linkages between sources of water quality deterioration, impact on human wellbeing and the institutions seen as responsible for dealing with the sources and impacts. This is accomplished through the use of the “Driving forces-Pressure-State-Impact-Response” (DPSIR) approach, a common framework for evaluating the relationships between human activities and environmental changes. This web of linkages, as perceived by residents, is then compared with current institutional arrangements. In doing so, we gain insight into the level of convergence and gaps in perceptions versus actual institutional responsibilities and responses.

The research was carried out in Whitsunday shire, located some 1,100 km north of Brisbane in the central coastal area of the State of Queensland in Australia. The main economic activity in the shire is tourism owing to the natural beauty of the landscapes and the proximity of the Great Barrier Reef. A previous mail-out survey conducted in the shire found that water quality was perceived by local residents as one of the top five contributors to their wellbeing (Larson, 2007).
The paper is organised as follows. We begin with an introduction to the case study, in Section 2 below. In Section 3, we outline the conceptual framework (DPSIR); we provide an overview of its origins and use to date, define the key components of the framework and discuss our use of the framework for the case study. Section 4 discusses the methodologies used. The analysis of the case study is presented in Section 5 and 6. In the former, we present the results of our interviews. This is followed by an overview of some of the institutional arrangements in place for water quality management, including the organisations responsible and their key roles at the time of writing. We conclude with a discussion of the implications of the misconceptions between current institutional arrangements and local residents’ perceptions.

2. Conceptual framework: DPSIR Framework

This research applied the DPSIR approach, a framework commonly used for evaluating relationships between human activity and environment degradation. DPSIR has been used as an analytical framework in a wide range of human–ecological systems, from watershed management (Fassio et al., 2005; Karageorgis et al., 2005), coastal management (Bowen & Riley, 2003) and fisheries management (Mangia et al., 2007), to water pollution (Pirrone et al., 2005) and environmental degradation assessment (Agyemang et al., 2007). The framework is most commonly used for the development of indicators (Bowen & Riley, 2003; EEA, 1999; Larson & Smajgl, 2006). However, it has also been used to organise information contained in management plans (Giupponi et al., 2004) and for stakeholder communication (Karageorgis et al., 2005).

The DPSIR framework was deemed appropriate for framing the analysis presented in this paper for two reasons. First, it previously had been used and worked well in the context of water quality (Nixon et al., 2003; Fassio et al., 2005; Karageorgis et al., 2005). Second, it has been used to further understanding of the impact of human activities and its effect on the biophysical and socio-economic environment. Furthermore, as Bowen & Riley (2003) argue, the DPSIR allows researchers to understand the nature and scale of social-biophysical interaction dynamics.

The DPSIR framework is based on the concept of causality: human activities exert pressures on the environment and change its quality and the quantity of natural resources. These changes in the condition of the environment result in society developing responses to the new conditions (EEA, 1999; Pirrone et al., 2005).

A generic DPSIR framework developed by EEA for water resources is presented in Figure 1 (based on Nixon, 2003). Gabrielsen & Bosch (2003) describe the DPSIR from a systems-analysis point of view: social and economic driving forces exert pressure on the environment and, as a consequence, the state of the environment changes. This leads to impacts on, for example, human health, ecosystems and materials that may elicit a societal response. The response feeds back on the driving forces, pressures, state and/or impacts, through adaptation or curative action. The model thus describes a dynamic situation, providing for various feedbacks in the system.

3. Methodology

This study was exploratory, with the principal goal of investigating local residents’ perceptions of a range of water quality issues and institutional responses and responsibilities in place, together with investigating the actual key water management institutions, responsibilities and actions. Thus two major
target groups for analysis were identified and selected: (a) community residents and (b) commonwealth, state and local water management institutions. Consequently, the study relied on two sources of data: interview data collected from local residents and secondary data on water management institutions. These are discussed in sequence.

Employing a convenience sampling technique, one-on-one, semi-structured interviews were carried out in February 2008 with 11 Whitsundays residents. These included seven women and four men, with ages ranging from early 20s to mid-50s, who had lived locally for from six months to over 35 years. The aim of these exploratory interviews was to gain insight into the diversity of community perceptions regarding issues related to water quality in the region. The interview schedule was designed using the DPSIR framework as a guide to the themes and sequence of questions. Collectively, the interview schedule aimed to address the following three broad questions:

1. What are the perceptions of the local residents about the (i) driving forces; (ii) pressures; and (iii) state of the water in their region?
2. For each change (past or anticipated change) in the state of the water mentioned, what are the perceived impacts (physical, biological or social)?

![Fig. 1. European Environmental Agency (EEA) generic framework for water.](https://iwaponline.com/wp/article-pdf/13/3/411/405777/411.pdf)
3. What are the perceived linkages between the specific impact and the societal (individuals, community, local government, state and national agencies) responses?

Key existing formal institutional arrangements on different scales (commonwealth, state, regional and local), governing the water sector in the Whitsundays shire were collected and analysed. Both legislative and planning instruments and the agencies in charge of enacting and administering them are presented.

4. Case study: the Whitsunday shire

The Whitsunday shire is adjacent to the Great Barrier Reef (GBR) World Heritage Area, a region of natural and cultural significance for both Australia and internationally. The shire’s Whitsunday Islands group, comprising 74 tropical islands, draw more than 700,000 tourists to the region annually (WDC, 2008). In addition to the GBR Word Heritage Area, the region hosts four national parks and several state forests; wetlands of national significance; protected habitats of endangered and endemic species; as well as 75 recorded Aboriginal archaeological sites (EPA, 2006).

The topography of the case study area is characterised by a combination of low mountains and hills that slope into fertile floodplains and coastal beaches. The landscape is dominated by dry tropical forest at higher elevations, cleared cultivated land and remnant patches of forest on the alluvial plains, wetlands and estuaries near the sandy coast. The climate in the Whitsunday shire is tropical, with wet season from December to March and an average daily maximum temperature of 28.8°C (OESR, 2005).

The total estimated resident population of the Whitsunday shire was 17,500 persons in 2005, with an average density of 6.5 people per km² over the shire area of some 2,700 km². The major townships of the shire include Airlie Beach (with an estimated population of 2,370 residents in 2003), Cannonvale (3,430) and Proserpine (3,350). The total population of the shire is expected to increase to some 27,300 residents by 2025, mainly due to interstate immigration (OESR, 2005).

Tourism-related services including accommodation, cafes and restaurants were the largest employer in the Whitsunday shire, employing 19.5% of the region’s labour force in 2001 (OESR, 2005). Almost all of the land in the shire is under agricultural production, although agricultural sectors combined employed only 6.5% of the shire’s workforce (OESR, 2005). Diffuse pollution from broad-scale agricultural land use and, in particular, from pesticide and nutrient applications have had a significant impact on water quality (Australian Government and Queensland Government, 2003).

A survey investigating perceptions of wellbeing of the shire’s residents, conducted in 2006, found that 88% of respondents selected water quality as contributing to their wellbeing. Overall, water quality ranked fifth in importance, following family relations, health, income and safety. However, satisfaction levels with current water quality were low. Of the five most important factors, the lowest satisfaction scores were assigned to water quality, with a score of 58 on a 100-point scale (Larson, 2007, 2008).

5. Results: from the perspective of Whitsunday residents

All of the residents interviewed described the state of the water in the Whitsunday shire as not being very good (see Figure 2). By far, the quality of drinking water was discussed most frequently, with nine interviewees bringing it up. Drinking water was described as “terrible” in terms of its taste and the fact that...
it is brown and stains; “it’s safe to drink but has a funny taste and smells” and “the worst I ever had…it is funny tasting…very chemically tasting…and is brownish and stains”. No-one perceived a health risk. A couple of people who lived in a remote section of the shire viewed the main issue with drinking water as being the lack of piped water. They depended on rain water tanks and the purchasing of truckloads of water. People whose main source of drinking water came from filtered rain tanks did not perceive any problems with that water. Aside from drinking water, people discussed the state of other bodies of water: water in the dam (Peter Faust Dam and reservoir which provides water for irrigation, flood mitigation and town water supply purposes; the reservoir is also a major recreational and in particular fishing spot in the region); water in the lagoon (a large, free access, open-air, man-made swimming complex built and operated by the council), in the creeks and rivers and in the marine environment. “Muddy” and accompanying low visibility were used to describe the state of the water in the lagoon, creeks, rivers, marine and the dam. Some of the creeks also suffered periodic episodes of low oxygen concentrations. In the marine waters, the high sedimentation events also resulted in a nutrient rich environment for fish. An additional issue encountered in these waters was the presence of rubbish.
The driving forces and pressures behind the poor drinking water quality were attributed to the drinking water infrastructure (treatment plant and pipelines) and the organisations responsible for running and maintaining this infrastructure (see Figure 2). The “shock treatment” of water with chlorine, particularly after rain events, was seen as one of the major driving forces behind the bad tasting water produced, with the brown colour of the water attributed to manganese leaching in the old pipelines. The unavailability of piped drinking water in remote regions was seen as the result of deficiencies in infrastructure, particularly the council’s perceived failure or lack of capacity to install water pipelines. The driving force behind the swimming lagoon’s muddy waters was attributed to the extensive urban development on nearby hillsides, combined with the obstruction of natural waterways such as creeks. In combination, these were seen as leading to significant sediment runoff during rain events, some of which drained into the lagoon. Urban development and overlap between the sugarcane cutting season and the rainy season were seen as creating main sediment pressures. In the marine waters, tourists visiting the Great Barrier Reef Marine Park were perceived as the major driving force behind the inappropriate disposal of rubbish into the sea. At the dam, major rain events during the wet season were mentioned as contributing to elevated water levels and to killing grass on the reservoir banks. This resulted in erosion of the banks and increased turbidity in the dam waters.

The impacts from the various states of water mentioned by the residents of the shire were numerous (Figure 2). In the case of the poor quality of drinking water, the impacts were: terrible tasting water, complaints by tourists, staining of washed clothes and the killing of fish in aquariums that used tap water. The additional expense for residents who had to purchase their drinking water was also mentioned, as well as impact of expenses on businesses in the area. In the case of the swimming lagoon, muddy conditions resulted in the facility being closed which meant that neither residents nor tourists could go swimming. Runoff of sediments and the accompanying muddy conditions in creeks, rivers, marine waters and in the dam resulted in two paradoxical impacts. On the one hand, low visibility made it difficult for fishers to see and catch fish; on the other hand, high nutrient levels that came with sediments attracted fish to the area (e.g. more fish appearing near the dam wall) and increased the number of fish available for fishing. In marine waters, low visibility also had a negative impact on snorkelers and snorkelling companies while episodes of low oxygen in creeks were stated to result in extensive fish kills.

These impacts were met with different responses, both at the individual as well as at the communal level (Figure 2). Individuals either filtered, boiled or refrigerated water coming from the tap or bought bottled water or used rain tanks. The majority of people we talked to viewed the local government (Shire Council) as responsible for the quality of water produced; only one person saw the responsibility fall to the company administering the water treatment plant. The local government’s responses were perceived on a scale from “doing nothing” to “trying” and being “compliant”. Respondents revealed that the council sent warnings to residents in the event of significant discoloration events and included discounts in water bills. Respondents were also under the impression that the old pipelines were being upgraded in some parts of the shire and a new treatment plant was being built. One resident felt that the state government should play a more significant role by providing financial support to the council to upgrade the infrastructure. In the case of the impact of the state of water in the swimming lagoon, rivers and marine environment, people felt that the council and the company operating the dam “couldn’t do much”.

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In summary, the responses to water quality issues were largely viewed as the responsibility of the local government, the Shire Council. The council was perceived as being responsible for delivery of the safe drinking water, control of the development permits and the control of the water quality in rivers, lakes and the sea. The next section of this paper will examine the formal institutional arrangement and the actual responsibilities for the quality of both drinking water and water in environment. The perceived and the actual arrangements will then be compared and discussed in Section 7.

6. Results: institutional arrangements for dealing with water quality impacts in the Whitsunday shire, Queensland

Australia has a highly complex and multi-scale set of institutional frameworks and arrangements governing water planning, management and monitoring (see ACIL Tasman 2005; Gentle & Olszak, 2007). In the Whitsunday shire, many of the policies, regulations and statutory authorities that influence water quality issues locally are defined and located outside the shire, at the national and state levels. In general terms, the local government is responsible for administering the land, the State of Queensland is responsible for all surface and marine water up to three nautical miles from the shore, while the Commonwealth is responsible for national marine waters between three and 200 miles and areas of national interest. Some of the most important water-related institutional arrangements are highlighted below.

6.1. Commonwealth level

At the Commonwealth level, surface freshwater quality use and management is overseen by the National Water Quality Management Strategy (NWQMS), a primary policy framework that oversees water quality regulations and planning across Australia (Stoeckl et al., 2006). The NWQMS was jointly developed in 1992 by the Australian Federal Government in cooperation with state and territory governments. The main objective of this policy is to “achieve sustainable use of the nation’s water resources by protecting and enhancing their quality while maintaining economic and social development” (DEWHA, 2008). As a part of NWQMS, several sets of water quality guidelines have been prepared, on both national and state levels, covering the issues of recreation, human drinking water, agriculture and stock watering, among others (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2000).

One of the most important institutional arrangements that link management of water quality on land and in coastal waters is the Reef Rescue Plan, a non-statutory instrument plan adopted by the Australian Federal government and the Queensland State government in 2003. The Reef Plan deals specifically with diffuse source pollution and provides strategies for actions to minimise the entry of those pollutants to the Great Barrier Reef through improvement in sustainability of land use practices: “The focus of actions (in the Plan) is relatively low cost measures to encourage good planning and to assist landholders in adopting best management practices that are both profitable and environmentally sustainable” (Australian Government and Queensland Government, 2003, p. 2).

In the past five years, the majority of Commonwealth and Queensland state funding and institutional arrangements for water quality planning, management and monitoring have focused on reducing diffuse sources of pollution, primarily from agricultural land use practices in coastal catchment areas and their
impact on coastal water quality. The location of the Great Barrier Reef Marine Park along Queensland’s coast is one of the main reasons for this focus. The Great Barrier Reef Marine Park, declared a World Heritage Area in 1981 and governed by multiple legislation, was proclaimed under the Great Barrier Reef Marine Act 1975. It is managed by the Great Barrier Reef Marine Protection Authority (GBRMPA), a national-level agency.

6.2. State level

Several agencies and legislative instruments govern water-related issues at the state level. The Queensland Water Act 2000 was prepared as a result of the 1994 Water Reform Agreement and is administered by the Department of Natural Resources and Water. The Water Act requires that all catchments in Queensland develop Water Resource Plans, the subordinate legislations of the Act. The Water Act 2000 is also linked to the National Strategy for the Ecologically Sustainable Development (section 11(b)), the Environmental Protection Act 1994 and the Environmental Protection (Water) Policy 1997 (Part 7).

The aim of the Environmental Protection Act 1994 is “to protect Queensland’s environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends” (Part 2, section 3). The main administrative and enforcing agency for the act is the Environmental Protection Agency. However, administration and enforcement of parts of the act can be devolved to local government. Among other issues, the act regulates disposal of liquid waste and thus point sources and sewerage system discharges must be licensed under the Environmental Protection Act.

The Environmental Protection (Water) Policy 1997 (EPP Water) was developed to identify environmental values for Queensland waters and to set water quality guidelines and objectives to enhance or protect the values identified. The Queensland Water Quality Guidelines 2006 complement national guidelines by including locally and regionally relevant water quality data for fresh, estuarine and marine waters.

The above legislative instruments work in parallel with the Integrated Planning Act 1997 (Department of Infrastructure and Planning), whose purpose is to achieve ecological sustainability by (a) coordinating and integrating planning at the local, regional and state levels, (b) managing the process by which development occurs and (c) managing the effects of development on the environment (Part 2, section 1.2.1). Urban development and building approval need to be in accordance with the Integrated Planning Act 1997, as well as with the Environmental Protection Act 1994, Water Act 2000 and the Coastal Protection and Management Act 1995.

In conjunction with the Environmental Protection Act 1994 and other legislation, the Coastal Protection and Management Act 1995 provides a “co-ordinated and integrated management and administrative framework for the ecologically sustainable development of the coastal zone” (Queensland Government, 2010). This act outlines statutory instruments that guide both state and regional policies for the management of coastal resources which are implemented in part via local government planning schemes. Water quality is amongst the natural resources addressed by policies aimed at managing major coastal zones. The State Coastal Plan establishes the long-term vision for the coast, identifies outcomes and principles for coastal management, while Regional Coastal Plans map and identify specific areas where the policies of the State Coastal Plan apply and give regional direction for State Coastal Plan policies.

Water planning and management is also outlined in the Smart Queensland: Smart State Strategy 2005–2015. One of the initiatives outlined under this strategy is Regional Water Supply Strategies which
are frameworks for assessing and planning for future water needs. Local councils work in partnership with
the Queensland government on these strategies and the Mackay and Whitsunday region is one of the
priority areas for implementing a Regional Water Supply Strategy (EPA, 2006).

6.3. Regional and catchment level

Institutional arrangements for water quality management at the regional and catchment scales are
interwoven with management of land and other natural resources. The most comprehensive of these are
catchment scale management authorities, plans and strategies. The institutional arrangements for catchment
management were defined in the 2000 National Action Plan for Salinity and Water Quality (NAP) and
initially funded by the National Heritage Trust (NHT2 programme). These institutions vary across states
and territories. In Queensland, natural resource management (NRM) bodies are non-statutory organisations
responsible for developing and implementing regional NRM strategies and plans in each of the 14 natural
resource management regions. The Whitsunday shire is located within the Mackay Whitsunday NRM
region. These catchment or multi-catchment level institutions do not focus specifically on the water sector,
but on natural resources in general (ACIL Tasman 2005).

One of the activities of the Queensland regional NRM bodies is to implement the actions outlined in the
Reef Plan, including the development and implementation of the regional Water Quality Improvement
Plans (WQIPs). The Mackay–Whitsunday WQIP was completed in May 2008 with the primary objective
of improving long-term water quality in the region. The WQIP comprises ‘‘Report Cards’’ each of which
covers distinct catchments in the region and provides an overview of the current conditions of the
catchments in terms of ambient and event freshwater quality. The WQIP also defines targets for water
quality for year 2050 and the required adoption rates of best land management practices that would need to
be achieved in order to meet the water quality targets.

6.4. Local level

The urban water management of potable water supply, wastewater and stormwater has been
compartmentalised as a result of the current structures of water authorities, government departments,
local authorities and private industry (ACIL Tasman, 2005). Planning for water infrastructure involves the
relevant state government departments, local government and major water suppliers in the region, who are
responsible for constructing, managing and operating water-related infrastructure (ACIL, Tasman 2005).
However, in most of the rural regions of Australia, local councils maintain their roles as primary water
services providers.

Under the Queensland Health regulations, councils are ‘‘expected to supply their communities with a
clean, safe supply of water that meets the Australian Drinking Water Guidelines’’ (Queensland Health,
2008). As water service providers, councils also need to comply with the Water Act 2000, as administered
by the Department of Natural Resources and Water.

In Queensland, most sewage treatment plants are built, maintained and operated by local government.
Operators are licensed under the Environmental Protection Act 1994 to discharge treated wastewater at an
acceptable environmental standard into waterways. The act is administered and the disposal licenses are
issued by the Environmental Protection Agency, while Department of Natural Resources advises local
governments on issues of managing, operating and maintaining sewerage systems and treatment plants.
The EPP Water requires local government to prepare and implement sewage management plans to ensure
that health and environmental standards are met. The Whitsunday Shire Council acknowledges that the sewage effluent currently released from their existing treatment plant is not expected to comply with the Environmental Protection Agency and Great Barrier Reef Marine Protection Agency (GBRMPA) requirements (GBRMPA, 2008).

A special issue facing the council in this case study is a problem of discoloured water. Council acknowledges that discoloured water has been an ongoing concern with residents for a number of years (WDC, 2008). According to the shire web site, the Whitsunday shire did not have a manganese problem before the dam was built. The source of manganese appears to be the geology beneath the dam’s reservoir, where water is dissolving manganese from the rocks. In order to address the issue, the council is constructing a new water treatment facility to remove the excessive iron and manganese that is present in the council water supply to enable it to comply to an acceptable standard.

7. Conclusions and practical implications

The current legislative arrangements related to water in Australia are complex and interrelated. This paper has provided an overview of only some of the institutional arrangements responsible for addressing water issues identified by the local residents interviewed.

Our review of institutional arrangements for water management highlight that in larger urban centres, water authorities at various stages of privatisation are typically responsible for delivering drinking water and wastewater services. However, some or all of these water-related services can remain in the hands of shire councils in rural areas. State-level EPA and health departments have responsibility for regulating water quality, in terms of environmental and human health standards, respectively. However, the providers of the water services are not registered with either of them but rather with the Department of Natural Resources and Water. This state-level department also has overall legislative responsibility for water in Queensland. Apart from the State EPA, the quality of water is also managed by regional non-statutory natural resources management bodies at the level of catchments (land) and by the national-level Great Barrier Reef Marine Protection Agency on the marine side. Both state and local agencies have responsibilities for urban planning and approval.

By contrast, in the eyes of the local residents of the Whitsunday shire the responsibility for all aspects of water use and management sits with the local council. This mismatch between perceptions and actual institutional arrangements and responsibilities is summarised in Figure 3. As the data presented in this paper were collected from a small, non-representative sample of residents and a partial analysis of institutional arrangements, Figure 3 by no means represents all local residents’ perceptions regarding water quality issues nor captures the entire set of actual organisations and agencies responsible for water management. Rather, Figure 3 is meant to highlight the existence of gaps between the perceived and actual water management responsibilities and to guide future research.

In terms of drinking water quality, the Shire Council was perceived as being responsible for water infrastructure and treatment, with financial support from the state and federal governments. In reality, although the Council is responsible for the delivery of the drinking water, it is under direct regulation from two state departments: Queensland Health Department and the Department of Natural Resources and Water. Formal institutional arrangements for the water in environment are far more complex. At least seven agencies are charged with various aspects related to environmental water quality, yet the perceived responsibility rested solely with the council.
The findings of this exploratory study suggest the need for better communication between policy makers and linked agencies and organisations on the one hand and local residents on the other hand. In particular, in this case study, the local council is held responsible for several water quality problems for which it has either limited or no responsibility or ability to take action. Therefore, local councils in particular could benefit greatly from improving their communication with their constituents. Improved communication could clarify the extent of councils’ responsibilities versus the responsibilities of the state and national governments. As a result, local council – supported by its residents – could potentially have a greater influence in lobbying the state and national government sectors for increased funding and other actions that would benefit both ecological and human water uses in the region. A good example of an area that might benefit from communication is the issue of manganese in the water. The relationship between the council and residents could benefit from further clarification of the reason for the presence of manganese in the water as a result of the geological process under the dam, rather than aged or mismanaged pipeline infrastructure. This could include communication strategies such as distribution of pamphlets, publication of information in local papers and town meetings.

In addition, the complexity of the institutional arrangements for management of both drinking and environmental waters appears to be well beyond what is perceived in the Whitsunday shire community. This might have significant consequences for the management of water in the shire in the future. As noted
in the review of institutional arrangements, government agencies and other organisations at the national, state and regional levels have developed multiple management strategies and plans. Some explicitly complement each other while others do not align adequately, leaving room for management gaps and misinterpretation. Moreover, some of these legislative and non-statutory plans depend on voluntary uptake by landholders and other community members. This complexity, coupled with expectations of voluntary uptake, present significant challenges. In one, community awareness of the existence of these regulations and associated management plans is often limited and confused.

Legislative and institutional reforms undertaken in Australia since the 1990s have introduced community participation into the development of plans and other legislative instruments as a formal requirement. However, the actual levels of participation in such processes vary and are often insufficient, resulting in the processes being viewed by local stakeholders as ‘imposed from above’ (McKay, 2005; Larson, 2006). The plans continue to be developed by government authorities with minimal input from people actually using water resources or being affected by changes in water quality. As such, it is not uncommon to have water management plans that landholders and other community members have limited capacity or interest to implement, or that conflict with existing local water uses and values, thus making voluntary uptake unachievable.

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References


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